## REMARKS

Applicant respectfully requests reconsideration of this application as amended.

Office Action Rejections Summary

Claims 1 – 5, 7 – 14, 16 and 17 have been rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent 6,150,223 to Chern et al. (hereinafter "Chern") in view of U.S. Patent 5,976,991 to Laxman et al. (hereinafter "Laxman"). Claims 15, 18 and 19 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Chern and Laxman as applied to claims 11 and 17, and further in view of U.S. Patent 6,235,597 to Miles (hereinafter "Miles").

Status of Claims

Claims 1 – 5 and 7 – 19 remain pending in the application. Claims 1 and 11 have been amended. The amended claims are supported by the specification and now new matter has been added. No claims have been canceled. No new claims have been added.

Rejections Under 35. U.S.C. § 103(a)

Claims 1 – 5, 7 – 14, 16 and 17 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Chern in view of Laxman. Applicant respectfully submits that claims 1 – 5, 7 – 14, 16 and 17 are patentable over Chern and Laxman.

Amended independent claim 1 provides:

> A method of forming sidewall spacers adjacent opposing vertical sides of a gate electrode, comprising:
>
> forming at least one gate electrode over a substrate;
>
> forming, at a first temperature in a range of approximately 550°C to 580°C and a first pressure of about 10 mTorr, a first silicon oxide film conformally over the substrate and gate electrode from a combination of gases including bis-(tertiarybutylamino)silane and oxygen;
>
> ***forming, at a second temperature in a range of 580°C to less than 600°C and a second pressure of about 65 Pascal, a silicon nitride film conformally over the first silicon oxide film from a***

***combination of gases including bis-(tertiarybutylamino)silane for about 49 minutes***; and

forming a second silicon oxide film over the silicon nitride film from a combination of gases including bis-(tertiarybutylamino)silane and oxygen; wherein the first temperature is less than the second temperature. (emphasis added)

Amended independent claim 11 provides:

A method of forming a transistor, comprising:

forming at least one gate electrode over a gate dielectric layer, the gate dielectric layer disposed on a substrate;

depositing a first silicon oxide film conformally over the substrate and gate electrode from a combination of gases comprising bis-(tertiarybutylamino)silane and oxygen at a first temperature of between approximately 550°C and 580°C and a pressure of about 10 mTorr;

***depositing a silicon nitride film conformally over the first silicon oxide film from a combination of gases comprising bis-(tertiarybutylamino)silane and ammonia at a second temperature of between 580°C and less than 600°C and a second pressure of about 65 Pascal for about 49 minutes***;

depositing a second silicon oxide film over the silicon nitride film from a combination of gases comprising bis-(tertiarybutylamino)silane and oxygen; and

forming a first sidewall spacer; wherein the first temperature is less than the second temperature. (emphasis added)

Chern discloses a method for forming a double-layer spacer. In particular, Chern includes the following disclosure:

Using the gate as a doping mask, ions such as Arsenic with concentration of about $10^{13}$ /$cm^2$ are implanted into the substrate 10, generally followed by a thermal driving and annealing in a temperature of about 900-1000°C. The cross-sectional view of FIG. 4 illustrates further steps of the formation of the tetraetheoxysilane (TEOS) 20A and 20B layer with about 200 angstroms in thickness being conformably deposited on the gate. In the embodiment, a low-pressure chemical deposition is applied. ***Next, a silicon nitride layer 22A and 22B and a second silicon oxide 24A and 24B are formed in order on the tetraetheoxysilane (TEOS) 20A and 20B layer by chemical vapor deposition (CVD).***

(emphasis added) (Chern, col. 2, lines 53 – 648, and FIG. 47)

As such, nothing in Chern teaches or suggests a deposition time for the formation of the silicon nitride layer.

Laxman discloses a method to form silicon oxynitride films. In particular, Laxman includes the following disclosure:

> The process involves reaction of bis(tertiarybutylamino)silane with $N_2O$ and $NH_3$ at 600°C and 500 mTorr reactor pressure. The precursor and reactants are introduced into the heated reactor, as in Example 1. Using 60 sccm BTBAS with varying amounts of $N_2O$ and $NH_3$, the film properties could be varied from a silicon nitride to various silicon oxynitrides. This is shown in the FTIR spectra normalized in FIG. 2. Here the percentages are of $N_2O$ in the mixture of $N_2O$ + $NH_3$ (total volumetric flow of 200 sccm). ***The average deposition rate varied from 20 to 29 Angstroms per minute, with higher rates occurring with higher percentages of $N_2O$.*** In FIG. 3, the full effect of changing the reactants is displayed. The temperature and pressure were maintained at 600°C and 500 mTorr for these depositions. The film refractive index then changed from near 2.0 (silicon nitride) to 1.46 (silicon oxide). This shows that a dielectric stack of oxides, nitrides, and oxynitrides may be deposited in a single reactor at a fixed temperature and pressure.
>
> (emphasis added) (Laxman, col., 8, lines 56 – 67)

As such, Laxman discloses a deposition rate for silicon nitride to various silicon oxynitrides, but does not disclose a deposition time for the formation of the silicon oxynitride films. As such, Laxman fails to cure the deficiency of Chern.

The Office Action states, "it would have been obvious to one having ordinary skill in the art at the time of invention to form the first silicon oxide (20), silicon nitride (22) and second silicon oxide (24) of Chern using a precursor silane including BTBAS at temperatures and pressure as taught by Laxman because BTBAS does not contain direct Si-C bonds thus, the deposited films have very low carbon content." (12/28/2004 Office Action, page 3, lines 19 – 21 and page 4, lines 1 – 2). Applicant also respectfully submits that there is no motivation to combine Chern and Laxman. Nothing in Lax suggests a deposition time for the formation of the silicon oxynitride film. As such, Applicant respectfully submits that Chern would not be motivated to look at Laxman for deposition times.

Even if Chern and Laxman were somehow combined, the combination would still not include all the limitations of independent claims 1 or 11. In particular, claim 1 includes the

limitation of "forming, at a second temperature in a range of 580°C to less than 600°C and a second pressure of about 65 Pascal, a silicon nitride film conformally over the first silicon oxide film from a combination of gases including bis-(tertiarybutylamino)silane for about 49 minutes" and claim 11 includes the limitation of "depositing a silicon nitride film conformally over the first silicon oxide film from a combination of gases comprising bis-(tertiarybutylamino)silane and ammonia at a second temperature of between 580°C and less than 600°C and a second pressure of about 65 Pascal for about 49 minutes." The combination of Chern and Laxman does not teach these limitations. As such, applicant respectfully submits that claims 1 and 11 are patentable over the combination of Chern and Laxman under 35 U.S.C. §103(a) and request removal of the rejection.

Claims 2 – 5 and 7 – 10 depend either directly or indirectly from independent claim 1 and thus claims 2 – 5 and 7 – 10 each include the limitation of "forming, at a second temperature in a range of 580°C to less than 600°C and a second pressure of about 65 Pascal, a silicon nitride film conformally over the first silicon oxide film from a combination of gases including bis-(tertiarybutylamino)silane for about 49 minutes." Claims 12 – 14, 16, and 17 depend either directly or indirectly from independent claim 11 and thus claims 12 – 14, 16, and 17 each include the limitation of "depositing a silicon nitride film conformally over the first silicon oxide film from a combination of gases comprising bis-(tertiarybutylamino)silane and ammonia at a second temperature of between 580°C and less than 600°C and a second pressure of about 65 Pascal for about 49 minutes." As such, applicant respectfully submits that dependent claims 2 – 5, 7 – 10, 12 – 14, 16, and 17 are also patentable over the combination of Chern and Laxman, and request removal of the rejection under 35 U.S.C. §103(a).

Claims 15, 18 and 19 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Chern and Laxman and further in view of Miles. Applicant respectfully

submits that claims 15, 18, and 19 are patentable over Chern, Laxman, and Miles. Claims 15, 18, and 19 each depend either directly or indirectly from independent claim 11 and thus include the limitation of "depositing a silicon nitride film conformally over the first silicon oxide film from a combination of gases comprising bis-(tertiarybutylamino)silane and ammonia at a second temperature of between 580°C and less than 600°C and a second pressure of about 65 Pascal for about 49 minutes." As discussed above, nothing in Chern or Laxman discloses this limitation.

Miles discloses a semiconductor structure having gates formed on a substrate. In particular, Miles includes the following disclosure:

> The generally L-spaced structure can be formed by blanket depositing a layer of silicon nitride followed by blanket depositing a layer 6 of silicon oxide. ***The silicon nitride can be formed by chemical vapor deposition. The thickness of the silicon nitride is typically about 100 to about 500 Å and more typically about 300 to about 400 Å.***
>
> (emphasis added) (Miles, col. 3, lines 17 – 23, and FIG. 3)

As such, nothing in Miles discloses or suggests a deposition time for the formation of the silicon nitride layer. Moreover, there is no disclosure in Miles of a pressure for the formation of the gate insulator. As such, Miles fails to cure the deficiency of Chern and Laxman. As such, Applicant respectfully submits that because the combination of Chern, Laxman, and Miles do not include all the limitations of claim 11, dependent claims 15, 18, and 19 are patentable over the combination and request removal of the rejection.

In conclusion, Applicant respectfully submits that in view of the arguments set forth herein, the applicable rejections have been overcome. If the Examiner believes a telephone interview would expedite the prosecution of this application, the Examiner is invited to contact Suk Lee at (408) 720-8300. If there are any additional charges, please charge our Deposit Account No. 02-2666.

Respectfully submitted,

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Dated: 3/28, 2005

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